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(54) Abstract Title

Portable ultra-violet light

(57) A portable, self-contained, electrically safe Ultra-Violet (UV) light is disclosed comprising a source of electrical power, a source of UV light and electrical / electronic means to connect the source of UV light to the source of power and convert it to a form suitable to operate the source of UV light. A miniature UV bulb or light emitting diode (LED) and internal battery power are taught. The miniature bulb is preferably of the low voltage (20-30V) type. External power sources, as back-ups, are also disclosed.

Optical means to focus and filter the light output are taught. A preferred design is a 'light pen' to fit in a pocket with other pens and is operated by using the clip as the switch. Further means of miniaturisation are disclosed.

The light may be used for detecting forged banknotes, documents, etc., identifying stolen goods and for medical or scientific purposes, etc.

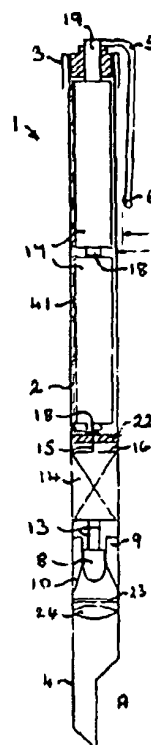
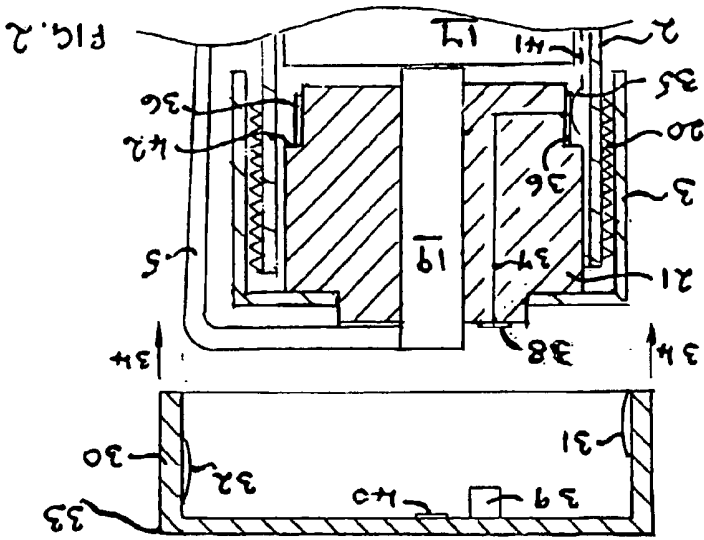
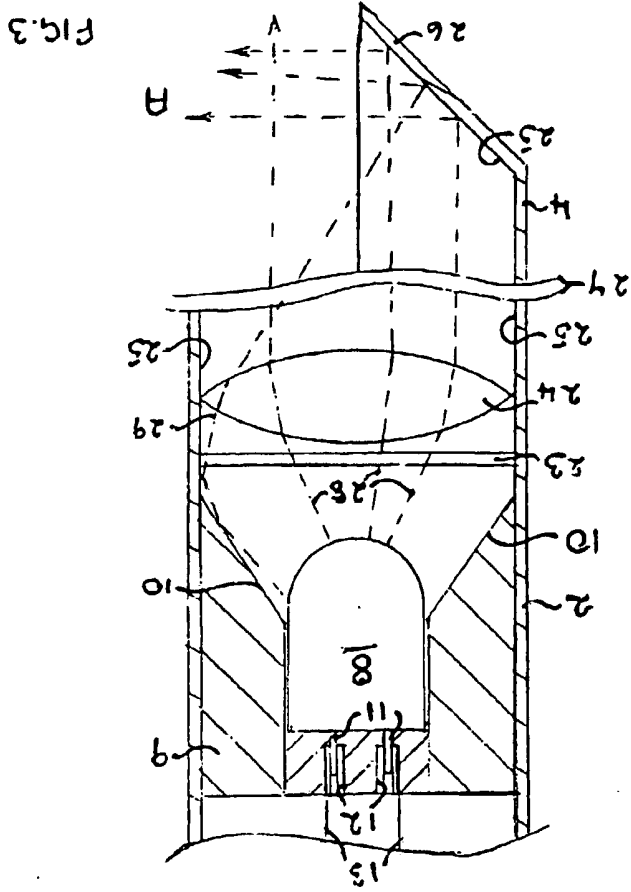
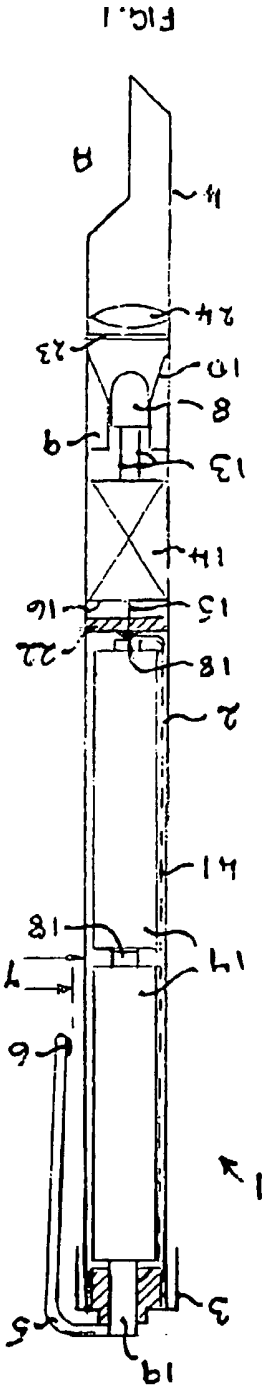


FIG. 1

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## PORTABLE ULTRA-VIOLET LIGHT

This specification relates to electrically safe, portable ultra-violet (UV) lights, such as may be carried by a person in a jacket pocket for use as and when required.

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Current designs of UV bulbs are relatively large, e.g. the size of a fist, and require high voltage power (e.g. 400-600V) to operate them. Such systems need a significant power supply, have their associated electrical systems and also require extensive insulation to ensure electrical safety for the operator. As such, these units are not portable, in the sense that the user can carry them around on his/her person, or in a toolbag, and use them as and when required, e.g. out of doors or away from mains power supplies. While it would be possible to provide a battery powered system, this would of necessity be heavy, bulky and inconvenient.

15 UV light is important in many forms of scientific work, for example, medical practitioners may use it to indicate skin conditions and many insects and birds have eyes which are sensitive to parts of the UV spectrum. One method of detecting forged bank notes is to examine them under UV light when the paper on which they are printed does not fluoresce in contrast to the majority of papers available to, and normally used by, forgers. As a further means of eliminating forgeries, some bank notes have printing which is visible only under UV light, for example, a ten denomination note may have the number '10' on it printed in this ink so that it is invisible in normal light but shows up strongly in UV light. These 'subliminal' figures are an important anti-forgery feature in some countries.

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It would clearly be advantageous if the police, and others involved with the detection of forged bank notes, could have a handy source of UV light, so that both the fluorescence and subliminal numbers could be checked during the course of their investigations, for example, when they detain a suspect in the street.

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One means of protecting valuables, e.g. computers, video recorders etc., is to mark the owners' details on the equipment using an UV marker. This leaves data which is invisible to the naked eye, but which stands out clearly under UV light. Police and Trading Standards investigators would find a portable UV source very useful when investigating suspects who are trying to sell such equipment cheaply and which may be stolen property.

There is thus a need for a portable, electrically safe UV light source which can, ideally, be carried in a jacket pocket and used as and when required, without connection to a separate power source.

According to the invention, there is provided apparatus for producing UV light, comprising:-

- i) a source of electrical power;
- ii) a source of UV light; and
- iii) electronic / electrical means to connect said source of UV light to said source of power and to convert the power to a form suitable to operate said UV light source;

characterised in that the apparatus is portable, self-contained and electrically safe.

According to a first variation of the apparatus of the invention, the source of UV light is miniaturised and includes a reflector to provide and concentrate the light output in a specific direction.

According to a second variation of the apparatus of the invention, the apparatus is mounted in a holding / carrying means with provision for directing the light output from the bulb on to a specific object.

According to a third variation of the apparatus of the invention, the holder / carrying means is provided with an electrical switch

According to a fourth variation of the apparatus of the invention, the holding / carrying means is provided with a shield to assist with concentrating the UV light on to a specific area.

- 5 According to a fifth variation of the apparatus of the invention, optical means are provided.

In a preferred example of the apparatus of the invention, the power source would be batteries and a miniature UV bulb or UV light emitting diode (LED) would be used.

- 10 Such bulbs or LEDs may be of the order of 5 mm diameter by about 10 mm long, or even smaller, and require 20-30V to operate them. Electrical / electronic means are provided to convert the battery output to the required power characteristics to operate the bulb / LED.

- 15 Any suitable form of container may be provided, but a cylindrical tube similar in size to that of a pen is preferred, as this will allow the battery(ies) to be located in line with the electrical / electronic means located nearer one end of the container and the bulb / LED located at that end and directed axially out of the end of the container. Such apparatus could be easily carried in a jacket pocket. A key fob is another possible form of  
20 container with the components arranged to fit the space available.

Preferably an electrical switch is incorporated into the container so that the UV light may be turned on and off, as required.

- 25 A combined bulb / LED holder and reflector would make best use of the space available and direct the light in a solid angle along the axis of the tubular container. Optical means, e.g. a collimating lens, may be used to focus the light and a hood or shield, e.g. an extension of the tube, may be used to direct the light more accurately onto a small target. Optical filters may also be used to select particular wavelengths of UV light.

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According to a sixth variation of the apparatus of the invention, mains or an external battery may be used as the source of electrical power.

According to a seventh variation of the apparatus of the invention, the internal power source may be rechargeable.

To economise on batteries, the container may be adapted for connection to an external power source, such as mains or a car battery. The electronics would then be designed to by-pass the internal batteries and so conserve their life. Alternatively, rechargeable cells may be used and the electronics adapted to recharge them whenever external power sources were used.

For a clearer understanding of the invention and to show how the same may be put into effect, reference will now be made, by way of example only, to the accompanying drawings in which:

Figure 1 is a sectional elevation of the apparatus of the invention;

Figure 2 is a part sectional elevation of the screw cap end of the container of Fig. 1 and also shows the provision of a separate cap for connecting an external power source; and

Figure 3 shows a part sectional detail of the optical arrangement.

In the following description, the same reference numeral is used for the same component or identical components fulfilling the same function.

Fig. 1 shows a section through a preferred design 1 of the apparatus of the invention. A cylindrical tube 2 is closed by a cap 3 and has a shielded outlet 4 through which the light is emitted. A clip 5 is provided to secure the apparatus in a pocket, like an ordinary pen clip. Two batteries 17, e.g. AAA size 1.5V, are fitted in series between cap 3 and insulator 22 where the positive terminal 18 of battery 17 contacts the end of a conductor 15. An electronics package 14 converts the batteries' output to the power required to operate UV bulb / LED 8 which is connected 13 to electronics package 14.

This disclosure makes use of the miniaturised UV light sources which have recently become available. These sources may be in the form of bulbs, light emitting diodes (LEDs) or any other suitable item of equipment. A particular feature of this type of light source is that it requires only low levels of power, e.g. 20-30V. Such low levels of voltage, and equivalent levels of current, make the apparatus intrinsically electrically safe with the normal types of insulator used on torches, etc. and other battery operated equipment. This is important, as the previously available types of UV bulb required power levels of the order of 400-600V, with concomitant safety implications. Such bulbs would not be operable by a portable battery power source.

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In this description, the term 'bulb' is used for light source 8 but this could equally well be a LED or any other low voltage UV light source.

A combined bulb holder 9 and reflector 10 holds bulb 8 and directs the light output forward through optical filter 23 to collimating lens 24 which produces essentially parallel rays of light down into the hooded extension 4 to concentrate the light output onto an object indicated by A.

Fig. 3 shows the detail of one optical arrangement. Wires 13 connect the sockets 12 in bulb holder 9 to electronics package 14. As shown, bulb 8 is a push fit with contacts 11 engaging in sockets 12. The forward facing cone of holder 9 forms a reflector 10 to direct light into hooded section 4. An optical filter 23 is shown as one example of the possible optical equipment which could be used. In this case it would be to select the required UV wavelengths, e.g. 330-370 nm.

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Light rays 28 are shown emitting radially from bulb 8 via filter 23 into collimating lens 24 from which they emerge as parallel rays, some of which will reflect off the polished internal surface 25 of the angled end 26 of hooded section 4. Another ray 29 is shown being emitted from the side of bulb 8 and reflected off surfaces 10 and 25 to pass through collimator 24 at a different angle, but will still be concentrated on the object at A, as shown by the dashed arrow. The means of securing filter 23 and lens 24 is not shown in detail, but will be obvious to the man skilled in the art. Also not shown is a

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means of separating tube 2 between bulb holder 9 and filter 23 so that bulb 8 may be replaced, if required. Another adaptation is that a range of slip-on hoods 4 may be provided for different applications of UV light pen 1.

- 5 Referring to Fig. 2, cap 3 is shown secured via screw thread 20 to the outside of tube 2. An insulator 21 is fast with the inside of cap 3 and contains an axial conductor 19 which contacts the bottom of battery 17, thus making the negative connection. Clip 5, fast with contact 19, extends downwardly along the side of tube 2. The end of clip 5 terminates in a contact 6 which, as shown by arrows 7, is clear of tube 2. By pressing clip 5 so that
- 10 end 6 contacts tube 2, the electrical circuit is closed and power flows from batteries 17 into electronics package 14. The electronics package is in electrical contact with tube 2 as shown by connection 16. Thus, closure of contact 6 will complete the electrical circuit and cause bulb 8 to be lit.
- 15 In an example of its possible usage, a traffic policeman may stop a suspect car and approach the driver. The policeman may have reason to believe the driver is passing forged notes and ask to see a note from his / her wallet. He will then be able to take UV light pen 1 from his pocket and, by pressing clip 6, examine the note to see whether the paper fluoresces or not and whether any hidden numbers are revealed by the UV light.
- 20 The use of hood 4, to concentrate the light onto object A, allows examination of the note in daylight and, if forged, will enable the policeman to arrest the suspect.

- The test for fluorescence is to some extent a 'negative' test in that, if it does not fluoresce, it does not necessarily mean that the note is genuine as it could have been
- 25 forged on non-fluorescent paper. However, the presence of subliminal UV numbers is a 'positive' identification of the note's authenticity. In addition to subliminal numbers, some banknotes are printed on paper containing specially added impurities which fluoresce under UV light and this is a further means of verification.



Another example of the use of the UV light pen could be when Trading Standards representatives visit car boot sales, etc. where electronic goods are being sold cheaply. An examination of the equipment with the UV light pen will show any identification markings which may have been placed there by the original owner, and prove if the goods have been stolen. Some spirits are produced especially for export and do not pay UK tax. It is not unknown for such merchandise to be stolen before leaving the country and to be sold illegally within the UK. Here again, subliminal UV markings could identify the goods.

- 10 Naturalists, medical practitioners, forensic and other scientists, etc. may use UV light pens for experiments with insects, etc., diagnostic tests, solving crimes or general scientific research.

A variation of the basic principle, to maximise battery life by using external sources of power, is shown in Fig. 2. A removable cap 30 may be fitted over cap 3 and clip 5 and held in place by springs 31, 32. An insulated conductor 41 (Fig. 1; shown as a dashed line) runs from connection 15 to a spring 35 (Fig. 2) which contacts ring conductor 36 fitted in annular recess 42 in insulator 21. Because recess 42 is an annulus, cap 3 can be screwed on and off without breaking spring 35 and spring 35 will contact ring 36 irrespective of the orientation of cap 3. Spring 35 is insulated from body 2 and is shaped so that batteries 17 may be slid in, or out, of body 2 past spring 35, without snagging.

Wire 37 connects ring conductor 36 to contact 38. Mating contacts 39 and 40 touch contact 38 and the end of conductor 19 respectively when cap 30 is fitted, to connect an external power source via lead 33. The external power could be AC mains, probably via a transformer, or a 12V DC car battery. Electronics package 14 would be adapted to convert the incoming power to that required for bulb 8 and to recharge cells 17, if they were of the rechargeable type. Thus, UV light pen 1 could be used by a scientist in the field, via the internal batteries, and, via mains, back in the laboratory. A policeman could use it at the roadside, via the internal batteries, and then place it in a holder in his car for recharging before he drove away.

One preferred example of a 'light pen' has been taught. In this case, the batteries and optical axis are in a single line but the disclosure lends itself to further miniaturisation. For example, batteries 17 could be located parallel to and alongside the optical section of the Fig. 1 example thus effectively halving the overall length and giving a small unit  
5 which would fit neatly in the palm of a hand. Similarly, the optical axis may be bent by the use of mirrors or prisms.

In the example taught, batteries 17 are the largest components. Smaller batteries are known, e.g. button-shaped lithium cells, and these could be used to design a further level  
10 of miniaturisation. Another preferred example of the application of the invention is to incorporate it into a container the size of a key fob, e.g. such as is used to lock and unlock cars, etc. In this case, not only would the battery be alongside the optics but the optical axis could be bent too. This is an example of further miniaturisation of the principle of the invention and is indicative of future developments. A disadvantage of the  
15 key fob design and smaller battery(ies) could be reduced operational life but, with frequent recharging, this may not be a problem.

The skilled man will be aware of other application for portable UV light sources and developments of the principle disclosed herein, all falling within the scope of this  
20 specification.

EP301

What we claim is:-

- 1      Apparatus for producing UV light, comprising:-
- 5      i)      a source of electrical power,
- ii)     a source of UV light; and
- iii)    electronic / electrical means to connect said source of UV light to said  
                source of power and to convert the power to a form suitable to operate  
                said UV light source;
- characterised in that the apparatus is portable, self-contained and electrically safe.
- 10
- 2      Apparatus for producing UV light, as claimed in claim 1, wherein the source of  
electrical power is an internal battery.
- 3      Apparatus for producing UV light as claimed as in claim 1, wherein the source of
- 15     electrical power is an external battery or mains.
- 4      Apparatus for producing UV light as claimed in claim 2, wherein the battery is a  
rechargeable cell.
- 20     5      Apparatus for producing UV light as claimed in any preceding claim wherein the  
UV light source is a miniature, low voltage bulb.
- 6      Apparatus for producing UV light as claimed in any preceding claim wherein the  
UV light source is a light emitting diode.
- 25
- 7      Apparatus for producing UV light as claimed in claims 5 or 6, wherein the UV  
light source is mounted in a combined holder and reflector.
- 8      Apparatus for producing UV light as claimed in any preceding claim wherein
- 30     containing means are provided to enclosed the components of the apparatus.

- 9      Apparatus for producing UV light as claimed in claim 8, wherein the containing means is adapted to direct the light produced by the bulb in a particular direction.
- 10      Apparatus for producing UV light as claimed in claims 8 and 9, wherein the  
5      containing means is a tubular member adapted to fit in the pocket of an article of clothing.
- 11      Apparatus for producing UV light as claimed in claim 10, wherein a switch is provided to turn the light on and off.
- 10      12      Apparatus for producing UV light as claimed in claim 11, wherein the switch is incorporated into a pocket clip on the tubular containing means.
- 13      Apparatus for producing UV light as claimed in claims 8-12, wherein a  
15      shield / hood is provided on the containing means to direct the light output into a particular direction.
- 14      Apparatus for producing UV light as claimed in claim 13, wherein the shield / hood is detachable from the containing means.
- 20      15      Apparatus for producing UV light as claimed in any previous claim wherein optical means are provided to control the UV light output.
- 16      Apparatus for producing UV light as claimed in claim 15, wherein the optical  
25      means includes a collimating lens.
- 17      Apparatus for producing UV light as claimed in claim 15, wherein the optical means includes an optical filter.
- 30      18      Apparatus for producing UV light as claimed in claims 10-14, wherein the inside of the tube and/or shield / hood are optically reflective.

- 19 Apparatus for producing UV light as claimed any preceding claim wherein  
miniaturised components are used to produce a small, compact unit.
- 20 Apparatus for producing UV light as claimed in claim 19 wherein the axes of the  
5 electrical and optical components are mutually arranged to promote miniaturisation of  
the unit.
- 21 Apparatus for producing UV light as claimed in claim 20 wherein optical  
components are used to reduce the overall length of the optical axis.
- 10 22 Apparatus for producing UV light as claimed in claims 19-21 wherein the  
containing means is a key fob or the like.
- 23 Apparatus for producing UV light as claimed in any preceding claim wherein  
15 external means are provided connectable to said apparatus for supplying external power.
- 24 Apparatus for producing UV light as claimed in any preceding claim wherein  
external means are provided connectable to said apparatus for recharging the internal  
cells.
- 20 25 Apparatus for producing UV light as claimed in any preceding claim for use in  
detecting forged banknotes, documents, etc.
- 26 Apparatus for producing UV light as claimed in any preceding claim for use in  
25 identifying stolen goods .
- 27 Apparatus for producing UV light as claimed in any preceding claim for use in  
medical and / or scientific work.

28 A method for producing UV light, comprising:-

- i) providing a source of electrical power;
- ii) providing a source of UV light; and
- iii) providing an electronic / electrical means to connect said source of UV  
5 light to said source of power and to convert the power to a form suitable  
to operate said UV light source;

characterised in that the apparatus is portable, self-contained and electrically safe.

29 A method for producing UV light as claimed in claim 28 wherein the overall size  
10 of the apparatus is minimised by using small components arranged in a compact manner.

30 Apparatus and method for producing UV light as disclosed in and by the above  
description with reference to the accompanying drawings.

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Application No: GB 9913578.2  
Claims searched: 1-30

Examiner: Dr Albert Mthupha  
Date of search: 7 October 1999

### Patents Act 1977 Search Report under Section 17

#### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F4R (RE, RGG, RL)

Int Cl (Ed.6): F21L (1/00, 7/00, 9/00, 15/00)

Other: ONLINE: EPODOC, JAPIO, WPI.

#### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WO 94/28519 A1 CZEWO PLAST, see abstract, the Figures & Claims 1, 9 and 10.	1-2, 5-6, 8, 19, 20, 25-29 at least.
X	US 5444263 A SYSTEC, see whole document, especially Figure 4 & Claims 1, 2, 15, 17.	1-3, 8-11, 15, 19-20, 23, 25-29 at least.
X	WPI Abstract Accession No. 1993-265670 & DE4204833 A1 (KUMAR), see abstract.	1 & 28 at least.
X	WPI Abstract Accession No. 1996-363857 & DE29603045U (THIE), see abstract.	1 & 28 at least.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.